THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of
Kazuhiro Oda et al.
Serial. No. : 10/593,338
Filed: September 19, 2006
For: ALUMINUM ALLOY FOR CASTING, HAVING HIGH RIGIDITY AND LOW LINER EXPANSION COEFFICIANT

Group Art Unit: 1793
Examiner: Roe, Jessee Randall

Declaration Under 37 C.F.R. § 1.132

Honorable Commissioner for Patents
Alexandria, Virginia 22313

Dear Honorable Sir:

I, Kazuhiro Oda, do hereby declare the following:

1. I received my Dr. of Engineering in Material Engineering from Tohoku University in March 1998. Currently, I am employed as a researcher at Nippon Light Metal Company, Ltd., which I joined in April 1998. Moreover, I am presently engaged in the research and development of Aluminum Shape casting, which I began on May6th, 1998.

2. I have reviewed the Office Action dated February 27, 2009, in which the claims were rejected under 35 U.S.C.102 and 35 U.S.C.103(a) as being unpatentable over *Nishi et al.* (US 4,919,736), and/or *Horikawa et al.* (JP 2000-204428). In the abovementioned Office Action, the Examiner asserted that the aluminum alloy having the present composition would have been obvious to one of ordinary skill in the art at the time the invention was conceived. Accordingly, in the absence of evidence to the contrary, selecting the claimed range of the compositions would appear to require no more than routine investigation by those of ordinary skill in the art. However, I will

hereinafter present direct comparative experimental results between the claimed invention and the inventions of the prior art, such as those of *Nishi et al.*, and *Horikawa et al.*, which will further demonstrate the unexpected properties of the present invention.

3. *Comparative Experiment*

I proceeded to manufacture the aluminum alloys of the present invention, as well as the aluminum alloys of *Horikawa et al.* and *Nishi et al.*, to thereby experimentally confirm the differences in the effects, i.e. rigidity and linear expansion coefficient, of the present invention and the inventions of *Horikawa et al.* and *Nishi et al.*, with said results thereof being described hereinafter.

The major compositions of the aluminum alloys described in each of the claimed inventions and the abovementioned Citations are listed in the below-indicated Table 1. Moreover, the major compositions of the aluminum alloys used in the present experiment are shown in Table 2. The aluminum alloy of the present experiment was employed in a manner to similar to that described in the present specification. Specifically, after being cast in a 200 mm × 200 mm × 10 mm planar form at a casting temperature of 720 degrees Celsius, it was allowed to sit at a temperature of 200 degrees Celsius for 4 hours, and then the rigidity (Young's modulus) and the linear expansion coefficient (thermal expansion coefficient) were measured. In the below-indicated Table 2, inventions 1-11 represent the aluminum alloys of the present invention, with the comparative examples of *Nishi et al.* and *Horikawa et al.* of Table 1 representing the alloy disclosed in the abovementioned Citation, which does not satisfy at least one of the conditions for the range of the compositions described above.

In accordance with the abovementioned experiment of the present specification, the criterion for Young's modulus is understood as being 90 GPa, with any composition having a value above this deemed as satisfying this criterion. In particular, any composition with a Young's modulus of 95 GPa is deemed as being even more superior. Moreover, the criterion for the coefficient of linear thermal expansion is understood as being 18×10^{-6} /°C, with any composition having a value lower than this deemed as satisfying this criterion. In particular, any composition with a coefficient of linear thermal expansion of 17.5×10^{-6} /°C is deemed as being even more superior.

Table 1

	Major Composition [mass%]						
	Si	Cu	Fe	Mn	P	Ni	Mg
Claim 4	13–25	2–8	0.5–3	1–3	0.001–0.02	–	–
Claim 5	13–25	2–8	0.5–3	1–3	0.001–0.02	0.5–6	–
Claim 7	13–25	2–8	0.5–3	1–3	0.001–0.02	0.5–6	–
Claim 8	13–25	2–8	0.5–3	1–3	0.001–0.02	0.5–6	–
Claim 9	13–25	2–8	0.5–3	1–3	0.001–0.02	0.5–6	–
Nishi	13.5–20	6–9	1.6–3	0.5–2	0.001–0.1	0–0.5	–
Examples	13.0–15.6	4.04–7.12	0.68–1.88	0.41–1.48	0.05–0.07	0.06–0.08	1.16–3.04
Horikawa	11–16	3–7	0.2–1.5	0.2–1.0	0.003–0.015	3–7	0.5–2.0
Examples	12.6	4.2	0.51	0.35	0.007	4.5	1.2

Table 2

	Major Composition [mass%]							Young's Modulus	Coefficient of Linear Thermal Expansion [/C°]
	Si	Cu	Fe	Mn	P	Ni	Mg		
Nishi 1	15.2	6	2	1.2	0.01	0	–	Poor	Good
Nishi 2	15.2	6	2	1.2	0.01	0.3	–	Poor	Good
Nishi 3	15.2	6	2	1.2	0.01	0.4	–	Poor	Good
Invention 1	15.2	6	2	1.2	0.01	0.5	–	Good	Good
Invention 2	15.2	6	2	1.2	0.01	0.6	–	Good	Good
Invention 3	15.2	6	2	1.2	0.01	0.7	–	Good	Good
Invention 4	15.2	6	2	1.2	0.01	0.8	–	Good	Good
Invention 5	15.2	6	2	1.2	0.01	0.9	–	Good	Good
Invention 6	15.2	6	2	1.2	0.01	1	–	Good	Good
Invention 7	15.2	6	2	1.2	0.01	3	–	Excellent	Excellent
Invention 8	15.2	6	2	1.2	0.01	6	–	Excellent	Excellent
Horikawa 1	13	5	1	1	0.01	4	1.5	Good	Poor
Horikawa 2	13	5	1	1	0.01	4	1.2	Good	Poor
Horikawa 3	13	5	1	1	0.01	4	0.9	Good	Poor
Horikawa 4	13	5	1	1	0.01	4	0.6	Good	Poor
Horikawa 5	13	5	1	1	0.01	4	0.6	Good	Poor
Comparative 1	13	5	1	1	0.01	4	0.3	Good	Poor
Comparative 2	13	5	1	0.2	0.01	4	0	Good	Poor
Comparative 3	13	5	1	0.8	0.01	4	0	Good	Poor
Invention 9	13	5	1	1	0.01	4	0	Good	Good
Invention 10	13	5	1	2	0.01	4	0	Good	Good
Invention 11	13	5	1	3	0.01	4	0	Excellent	Good

4. The abovementioned compositions and measurement results are shown in Table 2.

As shown in Table 2, when the aluminum alloy of the present invention was compared to that of the corresponding *Nishi et al.*, the alloy of the present invention had a superior Young's modulus, which clearly satisfied the abovementioned criterion of the present specification. Thus, this allows for the desired amount of $Al_3(Ni.Cu)_2$ to be produced, via the interaction between Ni and the specific composition described in the claims of the present specification, and allows for the desired Young's modulus (and

the desired coefficient of linear thermal expansion) to be achieved.

5. As shown in Tables 1 and 2, the aluminum alloy of the present invention differs from the aluminum alloy of *Horikawa et al.*, in that it does not include Mg, and that it includes a specific range of Mn content (although it incidentally is similar the alloy of *Horikawa et al.* in having Mn: 1.0 mass%). Depending largely upon these differences, the alloy according to the present invention was successfully obtained, with the appropriate values for the Young's modulus (e.g., above 90 GPa) and for the coefficient of linear thermal expansion (e.g., less than 18×10^{-6} /°C). In addition to the experiments on Young's modulus in the first Declaration, upon the present evaluation with regard to modifying the ratio within the range of composition according *Horikawa et al.* and that of the present invention, a composition capable of achieving the appropriate Young's modulus was obtained, as shown in Table 2, however, the appropriate coefficient of linear thermal expansion was not achieved with respect to the aluminum alloy according to *Horikawa et al.* For example, as understood from Horikawa 1-5 and Comparative Example 1, in cases where Mg is included and the appropriate Young's modulus is achieved, the appropriate coefficient of linear thermal expansion was not achieved. This is probably due to the fact that the Mg-free Si crystallized product of the present invention contributes more to achieving a low coefficient of linear thermal expansion (and high Young's modulus) than the Mg_2Si crystallized product that is formed by the alloy of *Horikawa et al.* Moreover, even when the Mn content is less than 1 mass% such as 0.2 or 0.8 or the like, as seen in Comparative Examples 2 and 3, an appropriate coefficient of linear thermal expansion still was not obtained.

Accordingly, the present invention obtained by incidentally duplicating the range of the composition of *Horikawa et al.*, deleting Mg, and specifying a specific range for Mn, the alloy of the abovementioned composition, demonstrates remarkable and/or particular effects of achieving both an appropriate Young's modulus and appropriate coefficient of linear thermal expansion over a claimed range, which is an effect that could not have been anticipated from either of the abovementioned citations.

6. In conclusion, I believe that the aluminum alloy with currently claimed range of compositions exhibits unexpected properties over *Nishi et al.*

(U.S. Pat. No. 4,919,736) and *Horikawa et al.* (JP 2000-204428), and thus, the present invention is not obvious in view of the abovementioned Citations.

7. I hereby declare all statements made herein as being true, that all information pertaining thereto is also believed to be true, and that all the abovementioned statements were made with full knowledge that any willfully falsified information, etc. is not only punishable by fines and/or imprisonment, as stipulated under Section 1001 of Title 18 of the United States Code, but may also jeopardize the validity of said application, as well as any patent issuing thereon.

Signature: Kazuhiro Oda

Date: May 21st, 2009